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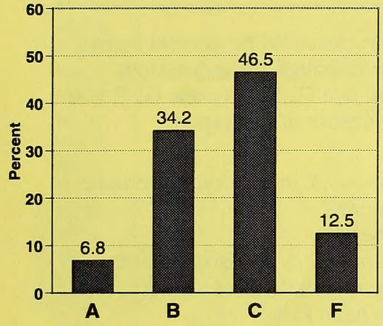
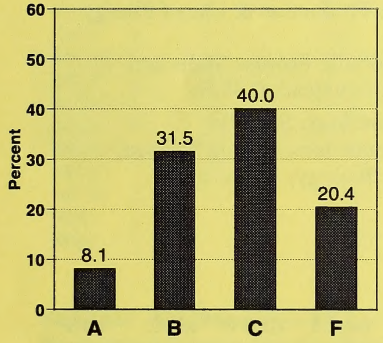
Science 30

Diploma Examination Results
Examiners' Report for June 1997

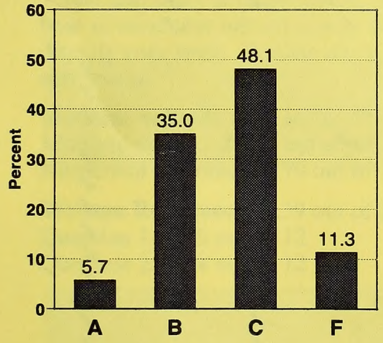
School-Awarded Mark



Diploma Examination Mark



Final Course Mark



The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the June 1997 administration of the Science 30 Diploma Examination. This information is most helpful when used with the detailed school and jurisdiction reports that have been provided to schools and school jurisdiction offices. A provincial report containing a detailed analysis of the combined January, June, and August results is made available annually.

Description of the Examination

The Science 30 Diploma Examination consists of 44 multiple-choice questions worth 55%, 12 numerical-response questions worth 15%, and two written-response questions worth 30% of the total examination mark.

Achievement of Standards

The information reported is based on the final course marks achieved by 720 students in Alberta who wrote the June 1997 examination.

- 88.7% of the 720 students achieved the acceptable standard (a final course mark of 50% or higher).
- 5.7% of students achieved the standard of excellence (a final course mark of 80% or higher).

Students demonstrated a good understanding of the basic scientific method by correctly designing an experiment and the observation tables that accompany the design.

Students continue to experience difficulty balancing nuclear reactions and calculating the energy produced by nuclear reactions. Although they were successful with some multistep problems, the manipulation of more complex formulas remains a challenge.

Students had difficulty with the concepts of refraction and diffraction, particularly when applied to astronomical concepts such as red and blue shift. Students were more successful with questions requiring calculations than they were when they had to demonstrate an understanding of these concepts.

Science 30 students continued to improve their communication skills. Their answers were generally well organized and all parts of the written-response questions were addressed. Responses could have been improved by greater use of specific examples to support ideas.

Approximately 48.2% of students who wrote the examination were female. Of these, about 81.0% achieved the acceptable standard on the examination, compared with 78.3% of the male students. Approximately 8.9% of the female students achieved the standard of excellence, compared with 7.2% of the male students. The average examination mark achieved by the female students was 61.0%, and the male students achieved an average mark of 60.6%.

Students First!
Student Evaluation

Alberta
EDUCATION

Provincial Averages

- The average school-awarded mark was 61.7%.
- The average diploma examination mark was 60.8%.
- The average final course mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 61.6%.

Results and Examiners' Comments

This examination has a balance of question types and difficulties. It is designed so that students achieving the acceptable standard will obtain a mark of 50% or higher, and students achieving the standard of excellence will obtain a mark of 80% or higher.

In the following table, diploma examination questions are classified by question type: multiple choice (MC), numerical response (NR), and written response (WR). The column labelled "Key" indicates the correct response for multiple-choice and numerical-response questions. For numerical-response questions, a limited range of answers was accepted as being equivalent to the correct answer. For multiple-choice and numerical-response questions, the "Difficulty" indicates the proportion (out of 1) of students answering the question correctly. For written-response questions, the "Difficulty" is the mean score achieved by students who wrote the examination.

Questions are also classified by general learner expectations. Even though some questions address more than one GLE, only one GLE was selected for the purpose of this report.

Knowledge:

GLE 1	Nervous, Circulatory, & Immune Systems
GLE 2	Genetics
GLE 3	Chemistry & the Environment
GLE 4	Gravitational, Electrical, & Magnetic Fields
GLE 5	Astronomy & the Electromagnetic Spectrum
GLE 6	The Production & Use of Energy

Skills:

SPSC	Scientific Process Skills and Communication Skills

Science, Technology, Society:

STS	Connections Among Science, Technology, & Society

Blueprint

Question	Key	Difficulty	GLE 1	GLE 2	GLE 3	GLE 4	GLE 5	GLE 6	SPSC	STS
MC1	C	0.404						✓		✓
MC2	B	0.801						✓		
NR1	4.36	0.208						✓	✓	
MC3	B	0.633			✓				✓	
MC4	C	0.447			✓					
NR2	3142	0.572				✓				✓
MC5	C	0.876								✓
NR3	20.0, 20	0.703				✓			✓	✓
MC6	D	0.494					✓			
NR4	1.16	0.647				✓			✓	✓
MC7	B	0.707				✓			✓	✓
NR5	4568	0.864						✓	✓	✓
NR6	2143	0.558						✓	✓	✓
MC8	A	0.715						✓		✓
MC9	C	0.531						✓		✓
NR7	2.2, 2.22	0.275						✓	✓	✓
MC10	A	0.801						✓		✓
MC11	C	0.593						✓		✓
MC12	C	0.557						✓		✓
MC13	A	0.756			✓					✓
NR8	4.55, 4.6	0.578			✓				✓	
MC14	D	0.649				✓				✓
MC15	B	0.700		✓						✓
MC16	A	0.524		✓						

Question	Key	Difficulty	GLE 1	GLE 2	GLE 3	GLE 4	GLE 5	GLE 6	SPSC	STS
MC17	C	0.424			✓				✓	
MC18	A	0.783				✓				
MC19	A	0.749	✓							
MC20	B	0.663	✓							
MC21	A	0.597	✓						✓	✓
NR9	2431	0.601	✓							
MC22	D	0.515	✓							
MC23	C	0.767	✓							
MC24	A	0.738	✓							
NR10	19.4	0.692				✓			✓	
MC25	D	0.725			✓					✓
MC26	D	0.865			✓					✓
MC27	C	0.771			✓				✓	
NR11	3142	0.596			✓					✓
MC28	D	0.490			✓				✓	✓
MC29	C	0.789			✓					
MC30	C	0.650			✓					✓
MC31	B	0.622		✓					✓	✓
MC32	D	0.815	✓							
MC33	A	0.904	✓							
NR12	2143	0.401		✓						
MC34	D	0.783	✓							
MC35	B	0.753		✓					✓	✓
MC36	A	0.565		✓					✓	
MC37	C	0.663	✓							
MC38	B	0.519					✓		✓	✓
MC39	B	0.339				✓			✓	✓
MC40	A	0.642					✓			
MC41	B	0.533				✓			✓	
MC42	B	0.293					✓			
MC43	A	0.507					✓			
MC44	A	0.526						✓	✓	
WR1		0.546							✓	✓
WR2		0.570							✓	✓

Subtests: Machine Scored and Written Response (Average by Subtest)

When analyzing detailed results, please bear in mind that subtest results **cannot** be directly compared. Results are in average raw scores.

Machine scored: 34.9 out of 56
Multiple choice: 28.18 out of 44
Numerical response: 6.70 out of 12

Written Response: 13.39 out of 24
Question 1: 6.55 out of 12
Question 2: 6.84 out of 12

General Learner Expectations:

GLE 1	Nervous, Circulatory, & Immune Systems	7.8	out of	11
GLE 2	Genetics	3.6	out of	6
GLE 3	Chemistry & the Environment	7.7	out of	12
GLE 4	Gravitational, Electrical & Magnetic Fields	5.9	out of	9
GLE 5	Astronomy & the Electromagnetic Spectrum	2.5	out of	5
GLE 6	The Production & Use of Energy	6.8	out of	12
Skills	Scientific Process and Communication Skills	26.2	out of	45
STS	Connections in Science, Technology, and Society	31.2	out of	51

Multiple-Choice and Numerical-Response Questions

2. Earth's **primary** source of energy is

A. tidal
***B.** solar
C. geothermal
D. gravitational

Use the following information to answer the next question.

Possible Characteristics of Electrical Energy Generating Methods

I Uses non-renewable fuel
II Contributes to acid rain
III Heats up water
IV Converts chemical potential energy
V Converts gravitational potential energy
VI Is not available during all seasons

8. Tidal energy includes which of the above characteristics?

***A.** V only
B. VI only
C. I and V only
D. II and VI only

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9. Three Canadian provinces use electricity generated by CANDU reactors. CANDU reactors produce heat through

A. phase changes
B. fusion reactions
***C.** fission reactions
D. chemical reactions

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12. When comparing the way energy is produced in the CANDU reactor with the way it is produced in the Sun, a major difference is that uranium nuclei are

A. split in the reactor and hydrogen nuclei are split in the Sun
B. fused in the reactor and hydrogen nuclei are split in the Sun
***C.** split in the reactor and hydrogen nuclei are fused in the Sun
D. fused in the reactor and hydrogen nuclei are fused in the Sun

Multiple-choice questions 2, 8, 9, and 12, and numerical-response 5 provide an indication of students' knowledge and understanding of energy production and use.

On **question 2**, 80.1% of the students responded correctly, demonstrating that they know the Sun is Earth's primary source of energy.

For **question 8**, students were required to choose a characteristic of tidal energy from a list. Of the students writing, 71.5% answered correctly. By choosing B, 15.1% seemed to confuse hydropower with tidal power generation. These students did not understand that since tides are caused by the gravitational effects of the Moon and Sun, seasons have little effect on the production of tidal energy.

For **question 9**, students had to recognize that heat in CANDU reactors is produced by fission reactions. Of the students writing, 53.1% answered the question correctly. By choosing B, 32.6% of the students demonstrated the common confusion between fusion and fission reactions. This is also evident in questions in which students must recognize a particular equation as either a fusion or fission reaction.

Students achieved about the same degree of success on **question 12**, which was answered correctly by 55.6% of the students. By choosing B, 23.5% of the students demonstrated that they knew the reaction in the Sun was different from that in a nuclear reactor, but they reversed the two processes.

Use the following information to answer the next question.

Energy Sources	
1	Coal
2	Propane
3	Natural Gas
4	Tidal Energy
5	Solar Energy
6	Wind Energy
7	Fission Reactions
8	Hydroelectric Energy

Numerical Response

5. The four renewable energy sources, listed in any order, are ____, ____, ____, ____.
(Record all **four** digits on the answer sheet.)

Answer: 4 568

38. Argon lasers that emit electromagnetic radiation with a wavelength of 514 nm are used to lighten port-wine stain birthmarks. The region of the electromagnetic spectrum that corresponds to a wavelength of 514 nm is the

A. X-ray region
***B.** visible region
C. infrared region
D. microwave region

39. A laser beam slows down as it passes from the air into the skin. If the frequency stays the same, there must be

A. an increase in wavelength
***B.** a decrease in wavelength
C. an increase in the number of waves per second
D. a decrease in the number of waves per second

Numerical-response question 5 required students to choose the renewable energy sources from a list of energy sources. Of the students who wrote the examination, 86.4% chose the correct energy sources.

Multiple-choice questions 38, 39, 41, and 42 provide an indication of how well students performed on questions dealing with electromagnetic radiation (EMR).

Question 38 required the students to find the value of 514 nm on the spectrum diagram in the data booklet and identify the frequency as visible light. Of the students writing, 51.9% selected the correct answer. By choosing A, 19.8% of the students indicated that they thought X-rays were used in the lasers. Some students may have related nanometres to the value of 10^{-9}. Since X-rays fall into this range on the diagram from the data booklet, they may have disregarded the "514" and assumed that they were using the correct section of the spectrum. They may also have chosen X-rays because they are used in other common medical applications.

Multiple-choice question 39 went beyond a simple calculation and required students to understand the relationships among the wavelength, frequency, and speed of EMR. At a "science literacy" level, students are expected to be able to predict the effect of changing a variable in a three-variable equation. Students found this challenging; only 33.9% answered correctly. By choosing C or D, 45.3% of students indicated that they thought the number of waves per second had changed. They made these choices even though it was stated in the stem that the frequency remains constant.

41. The communication devices used by the astronauts operated on a frequency of 4.91×10^7 Hz. The wavelength corresponding to this frequency is

A. 0.164 m
***B.** 6.11 m
C. 14.7 m
D. 100 m

Question 41 required a routine calculation of the wavelength of EMR, given the frequency. Of all students who attempted this question, 53.3% answered correctly.

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42. An astronomer observed a star that demonstrated redshift. The wavelength of the light emitted by the star appeared to have

A. decreased because the star was moving away from the lab
***B.** increased because the star was moving away from the lab
C. decreased because the star was moving toward the lab
D. increased because the star was moving toward the lab

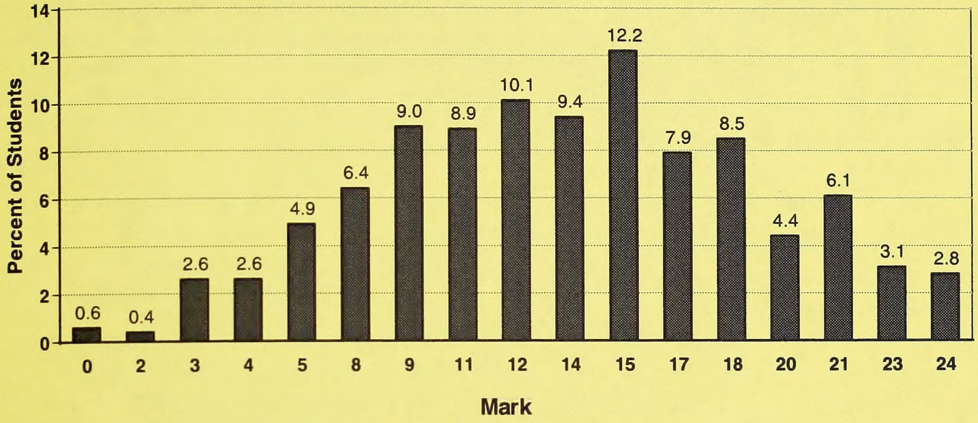
Question 42 required the students to interpret redshift as an increase in wavelength and to realize that this indicated that a star was moving away from the observer. Of all students, 29.3% answered this question correctly. By choosing A or B, 69.0% of the students indicated that they understood that redshift meant that the star must be moving away from the observer. The confusion seems to have been about what effect this would have on the wavelength of the EMR from the star.

Continued

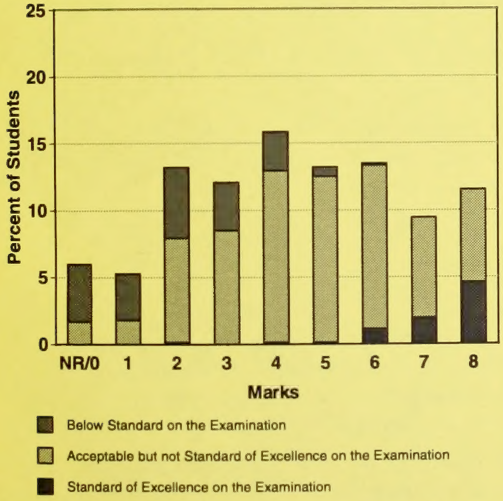
Written-Response Questions

Performance on written-response questions has improved steadily since the beginning of field testing in January 1994, where a large portion of students did not even attempt to answer the written-response questions. Many students are now using specific examples from science and technology in their responses. Of the students who wrote this examination, no student received no mark for both written-response questions, 64.6% received 12 marks or more out of 24, and 24.9% received 20 marks or more out of 24. The average mark on the written-response questions was 56.7%

Distribution of Marks for Written Response



Distribution of Marks for Question 1



Question 1 This process-skill question, which required the students to design a procedure and accompanying data tables, was attempted by all of the students who wrote the examination.

The first part of the question required students to write a purpose and a hypothesis and to identify the three types of variables. Almost all of the students who wrote the examination had no difficulty in accomplishing this part of the question. A few students confused the types of variables.

Most of the students designed a reasonable procedure and data table. The students achieving the standard of excellence prepared detailed procedures that took into account proper controls and used reasonable sample size. Their data tables were clear, properly labelled, and matched their procedures.

On this 12-mark question, the average was 54.6%. On this question, 63.5% of the student population achieved the acceptable standard and 20.9% achieved the standard of excellence.

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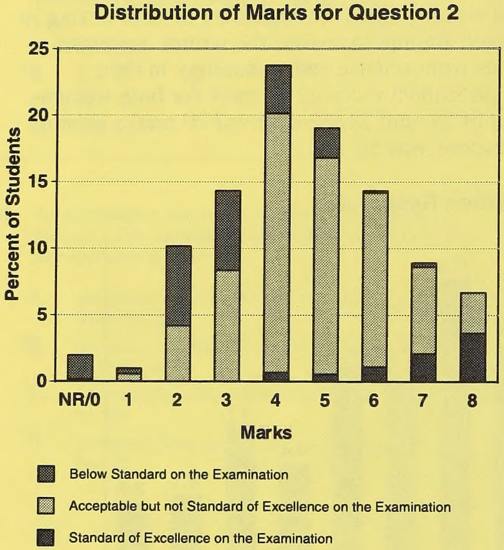

Question 2 All of the students who wrote the examination attempted this question. Most students were able to explain the meaning of David Suzuki's statement. Few students mentioned the irreversibility of some of our actions on the environment. Students who achieved the standard of excellence were able to represent their points of view clearly and use specific examples of pollution or environmental damage to support their position. Very few students described the role of politics in formulating solutions. Some students described how developments in science and technology might play a role in overcoming some environmental problems, especially in the area of renewable energy technology.

On this 12-mark question, the average was 57.0%. On this question,72.6% of the student population achieved the acceptable standard and 15.6% achieved the standard of excellence.

For further information, contact John Drader (jdrader@edc.gov.ab.ca) or Phill Campbell (pcampbell@edc.gov.ab.ca) at the Student Evaluation Branch at 427-0010.
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